This paper describes a simple, yet thorough, method for testing whether an optical scan vote-tabulator meets the **federal requirement** for a maximum of one error in counting 500,000 ballot lines.

Background:

Section 301(a)(5) of the Help America Vote Act of 2002[1] requires that all voting systems meet the accuracy standard set forth in Section 3.2.1 of the FEC's 2002 Voluntary Voting System Standards.[2] That standard defines "a target error rate of no more than one in 10,000,000 ballot positions, with a maximum acceptable error rate in the test process of one in 500,000 ballot positions."

While the Voting System Standards are voluntary (unless required by the State), the accuracy requirement for voting systems is NOT voluntary. It is federal law. Nevertheless, this part of the law has been all but ignored during the recent dramatic change in voting systems across the United States.

All new systems purchased after HAVA was enacted have been either 1) tested under the NASED (National Association of State Election Directors) certification process, and/or 2) tested under a State certification process. Neither process is thorough enough to determine whether the accuracy requirement mandated by Congress is met. Indeed, error rates far, far greater than the rate allowed by federal law have been observed in every election in virtually every one of the newly purchased voting systems.

Voting system vendors acknowledge that their equipment does not meet this standard. A case in point, On January 25, 2008, Diebold (now Premier) Election Systems sent an advisory to all Florida Counties using their optical scanners.[3] The advisory pointed to an "intermittent issue" with the scanner. Occasionally, the scanning stops, the ballot jams, and the scanner quits responding. The advisory warns:

> NOTE: It is important to understand that the ballot has not been tabulated in this situation, and that no error message is displayed.

My Proposal:

What follows is a simple proposal that would thoroughly test a scanning system to ensure that it complies with federal law. Note that it is not feasible to test Direct Record Electronic (DRE) voting systems this thoroughly. The time required and the risk of undetected human error are both much too high. If the ballots were entered at a rate of one every five minutes, it would take 1,544 hours (38 work weeks) to enter the ballots into the DRE. And if the results showed any errors, it would be impossible to tell if the errors had been made by the machine or by the people entering the ballots.

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[1] http://www.fec.gov/hava/law_ext.txt
[2] 2002 Voting System Standards. http://verifiedvotingfoundation.org/downloads/fecvss20020430.pdf
[3] http://www.votersunite.org/info/DieboldAdvisory25January2008.pdf

Step 1: A printer prints a deck of 2,400 identical single-sided, unmarked ballots (2365 for the test and 35 extra). Each unmarked ballot has the following 5 races and 28 ballot lines.

Race 1) **Title: Accept the Declaration of Independence.** Options: Yes and No.
Race 2) **Title: Son of Liberty.** Candidates: Samuel Adams, Thomas Paine, write-in.
Race 3) **Title: General of the Continental Army.** Candidates: George Washington, Ethan Allen, Francis Marion, Benedict Arnold, write-in.
Race 4) **Title: Chairman of Drafting Committee.** Candidates: John Adams, Benjamin Franklin, Thomas Jefferson, Robert R. Livingston, Roger Sherman, Write-In, None of the Above.
Race 5) **Title: Head of Pennsylvania Delegation.** Candidates: Robert Morris, Benjamin Rush, Benjamin Franklin, John Morton, George Clymer, James Smith, George Taylor, James Wilson, George Ross, Write-In, None of the above.

Step 2: The printer marks 2,310 ballots using the same proven technology used for printing sequential numbers on raffle tickets.

- For the first race, the printer alternately marks the yes and no selections, creating 1155 Yes votes and 1155 No votes.
- For the second race, the printer rotates though the three possibilities, creating 770 votes for each candidate.
- For the third race, the printer rotates though the five possibilities, creating 462 votes for each candidate.
- For the fourth race, the printer rotates though the seven possibilities, creating 330 votes for each possible Committee Chairman.
- For the fifth race, the printer rotates though the eleven possibilities, creating 210 votes for each candidate.

Because the number of candidates for each of the five races is a different prime number (2, 3, 5, 7, and 11) the printing process guarantees that the marked ballots contain every possible combination of votes, testing the scanner's ability to scan combinations accurately.

Step 3: Run this batch of 2,310 ballots through the optical scanner eight times. With 28 ballot positions on each ballot, 64,680 ballot lines are scanned at each run. Together, the eight runs will scan a total of 517,440 ballot lines.

Step 4: Mark and then scan 55 additional "tally distinction" ballots (1,540 more ballot lines). These are specifically marked for individual candidates to ensure that each candidate receives a unique number of votes. Otherwise, the accuracy of the results would be in question.

Preparing this test is simple and automated. Generating and printing the test deck is fully automated, except for the 55 tally distinction ballots. Once the deck is generated, it can be used over and over in scanners that accept the same type of ballot. Scanning the ballots is fully automated.

The table below shows, for each candidate, the number of votes in the initial test deck, the total number after eight runs, the additional "tally distinction" votes, and the expected results of the entire test.

Total Ballots Cast	18,535
Total Lines Scanned	518,980

Race	Candidate	Initial Deck	After 8 runs	Tally Distinct	Expect Result
Accept the Declaration of Independence	Yes	1155	9240	1	9241
	No	1155	9240	0	9240
Son of Liberty	Samuel Adams	770	6160	2	6162
	Thomas Paine	770	6160	1	6161
	Write-In	770	6160	0	6160
General Of the Continental Army	George Washington	462	3696	4	3700
	Ethan Allen	462	3696	3	3699
	Francis Marion	462	3696	2	3698
	Benedict Arnold	462	3696	1	3697
	Write-In	462	3696	0	3696
Committee Chairman	John Adams	330	2640	6	2646
	Benjamin Franklin	330	2640	5	2645
	Thomas Jefferson	330	2640	4	2644
	Robert R. Livingston	330	2640	3	2643
	Roger Sherman	330	2640	2	2642
	Write-In	330	2640	1	2641
	None of the Above	330	2640	0	2640
Head of Pennsylvania Delegation	Robert Morris	210	1680	10	1690
	Benjamin Rush	210	1680	9	1689
	Benjamin Franklin	210	1680	8	1688
	John Morton	210	1680	7	1687
	George Clymer	210	1680	6	1686
	James Smith	210	1680	5	1685
	George Taylor.	210	1680	4	1684
	James Wilson	210	1680	3	1683
	George Ross	210	1680	2	1682
	Write-In	210	1680	1	1681
	None of the above	210	1680	0	1680

Conclusion:
More than one error in the results would disqualify the scanner as a legal voting system in the United States, as required by federal law.